

Town of Palm Beach

Phipps Ocean Park Beach Restoration Project

JCP File No.0165332-001-JC

Supplementary Geotechnical Analysis

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by

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I. Introduction

Background: The restoration of the beach at Phipps Ocean Park includes placement of up to 1.5 million cubic yards of fill over about 1.9 miles of Atlantic Ocean shoreline in Palm Beach, Florida. The project is proposed by the Town of Palm Beach with financial support from the State of Florida *Erosion Control Program*.

Two offshore borrow areas have been proposed for the Project. These are designated as Borrow Areas III and IV and generally located about 1.5 miles south and 2.6 miles south of the fill area mid-point, respectively; about 3,500 feet offshore.

In January 2000, on behalf of the Town of Palm Beach, Coastal Tech filed an application for a *Joint Coastal Permit* (JCP File No. 0165332-001-JC Palm Beach County). The Florida Department of Environmental Protection (DEP) has expressed concerns regarding the character of the proposed fill material relative to the Department's rules as cited in Ch. 62B-41.007(2)(j) - particularly relative to the coarse gravel and cobble content.

On June 26, 2000, Coastal Tech submitted additional information to DEP including an estimate of "the percent (by volume) of rock in the borrow areas" - "based on inspection of the cores and review of core photography" and where "rock" was "defined as any material with dimensions greater than

$\frac{5}{8}$ " ($\sim 4^{\circ}$) which is the largest mesh size reflected in the sample gradation analysis."

Purpose: The purpose of this *Supplementary Geotechnical Analysis* is to provide a more reliable quantitative characterization and comparison of the coarse gravel and cobble content within proposed borrow areas and the native beach sands along the fill area of the Phipps Ocean Park Beach Restoration Project. The prior analysis was based on visual estimates; the data presented herein is based on quantitative measurements.

II. Methods

Transect Sampling: At the eleven monuments R116 - R126 (inclusive) within the Project fill area, Coastal Tech collected samples of the native beach at (1) toe of dune, (2) mid-berm, and (3) top of foreshore slope. A total of thirty three (33) samples were collected. At each station, material was:

1. collected as a continuous sediment sample using a post-hole digger between 0 and -30 inches depth,
2. passed through a metal screen to separate any coarse gravel and cobble from the bulk sample, and
3. collected until ~5 gallons of screened material was retained in a calibrated plastic bucket.

The coarse fraction was placed in a labeled sampling bag for further analysis.

Targeted Sampling: At four (4) locations within the fill area - where extensive coarse gravel and cobble are evident - Coastal Tech obtained additional samples. These samples are intended to establish a threshold for acceptance of fill material.

Borrow Area Sampling: A total of seven (7) cores were screened as outlined above to provide a basis for characterization of the borrow areas. Four cores were obtained in Borrow Area III and three cores in Borrow Area IV. These cores were originally ~15 ft in length, but subsequent to acquisition subject to sectioning into 3 - 5 shorter intervals to facilitate transportation, inspection, and storage. Textural analysis was performed on the archived half of each section; i.e., these cores had not been subject to any analyses which may have altered the results of this investigation.

Analysis: Upon return from the field, the material retained on the screen was immersed in a calibrated container of water from which its displaced volume could be observed (Exhibit 1). The coarse fraction was then expressed as a percent, by volume, of the total (bulk) sediment sample.

For each sample, the following parameters were tabulated:

1. the location of the sample,
2. the volume of sand within the collection bucket,
3. the volume of coarse gravel and cobble, and
4. the percent of coarse gravel and cobble by volume,

III. Results

Transect Sampling: On September 7, 2000 Coastal Tech sampled along transects adjacent to the eleven monuments within the Project fill area. At each cross-shore station, a continuous sediment sample was obtained using a post-hole digger at depths between 0 and 30 inches. This material was passed through a plastic bucket wherein the bottom was cut out and replaced with a metal screen capable of separating coarse gravel and cobble-sized sediment from the finer fraction. The screened bucket was stacked on top of another 5 gallon bucket which had been previously calibrated to denote elevations equivalent to sediment volumes as large as 5 gallons. Both whole and one-half gallon intervals were marked on the calibrated bucket.

To facilitate screening, both buckets were continuously shaken relative to the horizontal and vertical plane. Sediment was added until the volume collected in the calibrated bucket reached an elevation at or greater than 4 gallons. In general, one post hole -30 inches deep yielded a sediment sample size of 4 to 4.5 gallons.

A summary of data generated from analysis of the native beach is shown in Table 1.

Targeted Sampling: The presence of gravel hot spots - areas where extensive coarse gravel and cobble are evident - has been masked by a beach raking maintenance program which disrupts concentrations of shell, rock or other beach debris and redistributes this material over a broader area or into collection piles. Apparently, Phipps Ocean Park Beach is raked on a daily basis. We observed this program in action during our sampling and believe the net result is a reduction in the number, size and location of gravel hot spots. Four targeted samples were collected from areas where extensive coarse gravel and cobble are evident.

The post-hole digger was used to obtain haphazard samples of the beach surface layer (0 ~12 inch depth) until as much as 5 gallons of sediment was collected. A summary of data generated from analysis of targeted samples is shown in Table 2.

Borrow Area Sampling: On Friday, September 8, 2000, Coastal Tech sampled sediment cores obtained in Borrow Areas III and IV and made available by Coastal Planning and Engineering (CP&E). A continuous sample was obtained from each undisturbed (archive) core by passing the sediment present on each core section through the bucket stack. This destructive sampling process was observed by CP&E. A summary of the data generated from analysis of borrow area cores is shown in Table 3.

IV. Significant Observations

Transect Sampling: The following summarizes observations from sample analysis results for transect samples:

1. Coarse fraction was not recovered in 13 (41%) of the samples. Gravel-sized material was retained during the screening of 19 (60%) samples. One of these samples contained a measurable volume of gravel-sized material (0.1%); the balance was not of sufficient volume to quantify using the methods employed during this project.
2. Gravel -sized material consists of limestone fragments (rock) and modern bivalves (molluscs).

Targeted Sampling: The following summarizes observations from sample analysis results for targeted samples:

1. Volume of coarse fraction is between 0.3 and 0.7% per gallon of sediment.
2. Higher content of gravel-sized material (Exhibit 2) reflects increase in molluscs.

Borrow Area Sampling: The following summarizes observations from sample analysis results for borrow area core samples:

1. Volume of coarse fraction is between
 - a) 0.1 and 4.8% per gallon per section
 - b) 0.2 and 2.8% per gallon per core
2. Gravel-sized material in the borrow areas (Exhibit 3) is distinguished from that obtained from the native beach (Exhibit 1 and 2) by the presence of:
 - a) stick coral (modern) and coral fragments (fossil?; Exhibit 4)
 - b) encrusted and fragmented shells (fossil?)
3. The highest gravel values were found in the upper-most section of cores 79 and 94.
4. Cores closest to the relict coral reef terrace (79, 94 and 89) contain the highest coarse fraction, suggesting the sediment is deposited in association with storm induced sediment transport. Clast composition and stratigraphic distribution support this supposition.
5. Borrow Area IV contains less gravel than Area III.
6. To optimize probability of encountering sediment with low gravel content, additional exploration should focus on: (1) areas distal to the reef terrace and (2) proximal or within Borrow Area IV.

V. Summary

This *Supplementary Geotechnical Analysis* provides a quantitative characterization and comparison of the coarse gravel and cobble content within proposed borrow areas and the native beach sands along the fill area of the Phipps Ocean Park Beach Restoration Project. The results suggest the two areas are similar; each containing several percent gravel and cobble content. As there are myriad sources of potential error or variance, quantitative estimates of this sort should be viewed with caution until a more rigorous method of analysis can be developed.

An analysis of potential error introduced during the process of field sampling and laboratory analysis suggests the largest source of error occurs during the process of sieving (Table 4). The native beach is sorted and compacted by "surf beat". Our sampling method disturbs grain-to-grain relationships and re-packs the sediment; the coring procedure also alters grain packing. It is unclear what the net effect of all of these variables has had on this project. Inspection of Table 5 suggests an error of 20% of the sample volume could easily be introduced by sediment compaction during the sieving procedure alone. Discriminating between 2% or 3% is therefore somewhat problematic.

It should also be noted the characterization of native beach gravel content was conducted at the end of the summer season, when wave heights are generally below the annual average, and therefore these analyses should be considered as conservative (minimal). The mean gravel content of Phipps Beach is probably more similar to the targeted samples, which averaged about 1%. Given the Project area is subject to beach raking, which redistributes and therefore reduces the gravel content at any particular site, even these estimates of native beach gravel content are probably below the long-term average.

All things considered, is not unreasonable to speculate *in situ* gravel content of Phipps Beach to be between 1% and 3% during the winter months and in conjunction with an interval of no raking. These values are similar to Borrow Areas III and IV. Compatibility may be improved by modifying the proposed cut template (i.e., shifting westward) in Borrow Area III.

Conclusions: Based on the above results, the borrow areas are proposed to exclude the areas containing a relatively high content of coarse gravel and cobble. Attached are revised permit sketches (sheets 7-12) reflecting the revised borrow areas. Table 5 summarizes the character of the borrow area material as revised.

The accuracy of the results is estimated at about $\pm 0.5\%$. The composite of borrow material is expected to have a content of coarse gravel and cobble at about $0.2\% \pm 0.5\%$. The transect samples indicate that the native beach has a content of coarse gravel and cobble at less than $0.1\% \pm 0.5\%$. The targeted samples indicate that the some areas of the native beach have a content of coarse gravel and cobble at $0.7\% \pm 0.5\%$.

Based on the above, it is concluded that the proposed borrow areas have a content of coarse gravel and cobble ($0.2\% \pm 0.5\%$) similar to the native beach (0% to $0.7\% \pm 0.5\%$).